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ABSTRACT

A study examined the role of technicians in the fiber optics industry and determined those elements that should be included in a comprehensive curriculum to prepare fiber optics technicians for employment in the Texas labor market. First the current literature, including the ERIC database and equipment manufacturers' journals were reviewed. After the continuum of job tasks required for fiber optics technicians was identified, the occupational skills required of fiber optics technicians in the Texas labor market were analyzed through a users' survey. An advisory committee of representatives of business/industry technical educators, other educators, and Texas Education Agency personnel was formed. Data from the literature search, advisory committee input, and site visits to fiber optics plants in Texas and a fiber optics conference were incorporated into recommendations concerning an appropriate training curriculum for fiber optics technicians and suggested methods for providing services to special needs students. Finally, all materials developed during the project were validated. (Appendixes to this report, which comprise more than half the document, include the industry needs survey, and equipment list for training stations, a list of fiber optics manufactures, quarterly project reports, a task analysis, and a list of advisory committee members.) (MN)

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Final Report
FIBER OPTICS TECHNICIAN
Curriculum Research Project

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Final Report
FIBER OPTICS TECHNICIAN

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June 30, 1985

FIBER-OPTICS PROJECT

FINAL REPORT

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I. Introduction

Rational

Fiber optics technology results from the superior capacity of lightwaves to carry a communications signal. Early research in lightwave technology was hampered by the lack of an intense enough light source and by the lack of a medium through which the light beam could travel without excessive attenuation. With the development of lasers in the 1960's and commercial-grade silicon fiber in the 1970's, use of fiber optics began accelerating in the telecommunications industry, primarily in long haul systems. Advancements in recent years in technology which have made greater application possible include the lowering cost of complex interfacing equipment, improvements in cable-splicing technique, and reduction in the cost of the cable itself.

Since that time, the U.S. has taken its place as a world leader in fiber optics, both as a producer and user of the technology. Although not recognized by the U.S. government as a statistically-defined industry,* the U.S. fiber optic producer group is comprised of companies which manufacture systems and components, including optical fiber, cable, and electro-optic devices such as transmitters, connectors, repeaters, and receivers. The chief user of fiber optics technology is the telecommunication industry; however, other major applications include six main areas: data processing, security systems, local area networks, closed circuit television, industrial applications, and military applications.

According to a 1984 U.S. Department of Commerce report,

> The overall world market for fiber optics systems (including the glass fiber cable and the electronic components attached to the cable) was $625 million in 1983 and is expected to top $1 billion in 1985...

* The U.S. Government defines an industry as a group of establishments involved in a primary activity that is statistically significant in the number of people employed, the volume of business done, and other measures of economic activity. This group is a disparate group of companies producing equipment that may or may not be used in fiber optics systems. Because manufactureres of fiber optics products make many other items of greater value, they are not classed within a single industry.

The leading markets for 1982 for fiber optics projects, in order, were the United States, Canada, Japan, the United Kingdom, France, and West Germany. Australia plans a network providing up to 60,000 voice channels; Brazel has begun factory production of cable; the Peruvian Telephone Co. is installing a fiber optic link in Lima. In Africa, twenty-one fiber optic systems have been installed, with start of a production plant planned for next year. It seems that fiber optics has become the "preferred transmission medium" among users of communications and information around the world. The U.S., however, will continue to be the leading producer and user of fiber cable and components.

Table 1
FIBER OPTICS MARKET ESTIMATES
($ MILLION)
(Includes fiber, cable, and electronic components)

	U.S.	World
1981	$190	$290
1982	$290	$450
1983	$400	$625
1984	$560	$900
1985	$725	$1,225
1986	$880	$1,600
1987	$1,135	$2,110
1988	$1,450	$2,670
1989	$1,650	$3,200

Source: Office of Telecommunications,
International Trade Administration,
U.S. Department of Commerce

World Fiber Optics Market by Major Components

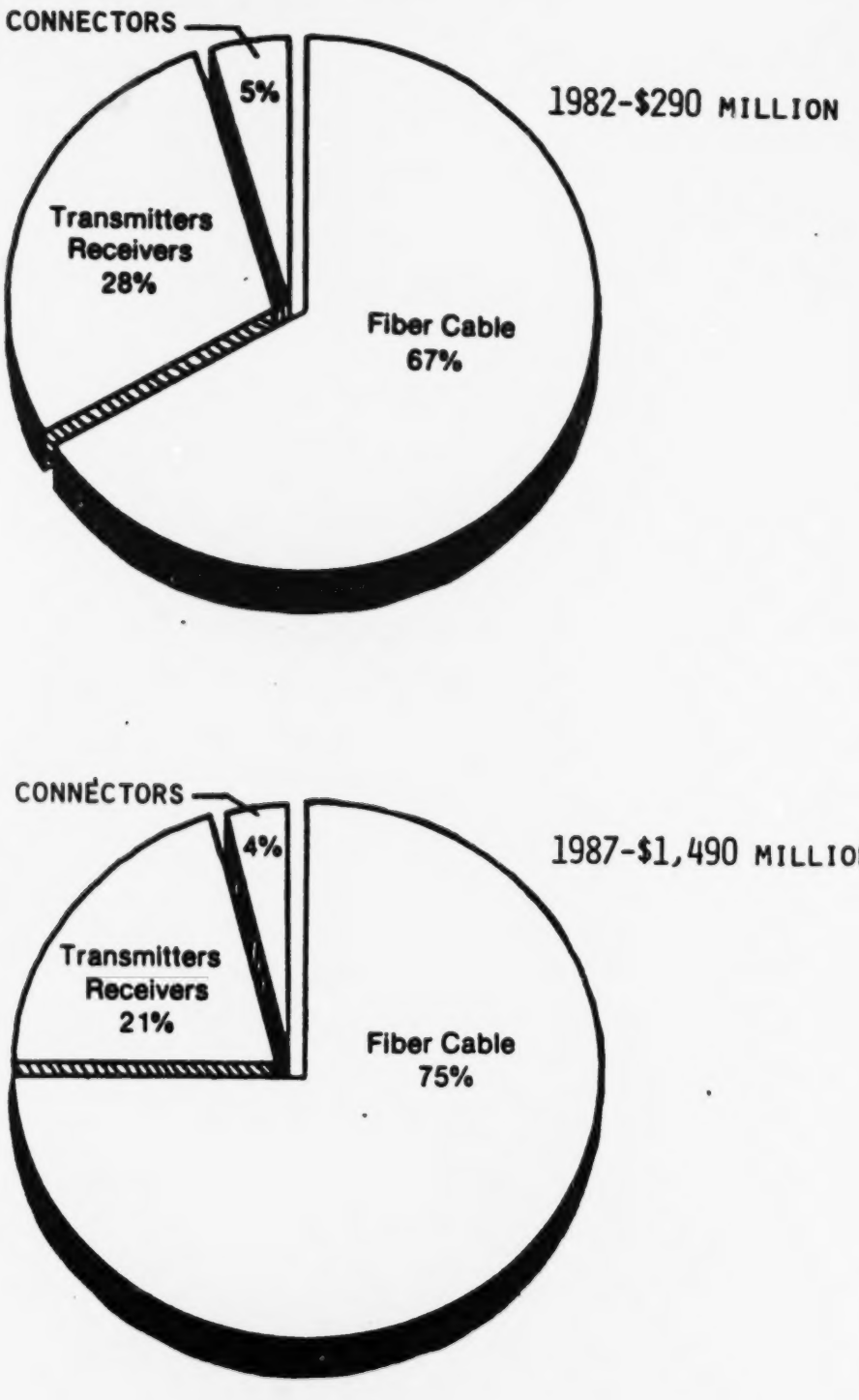

FIGURE 1

SOURCE: KESSLER MARKETING INTELLIGENCE

BASIC FIBER OPTIC COMMUNICATION SYSTEM

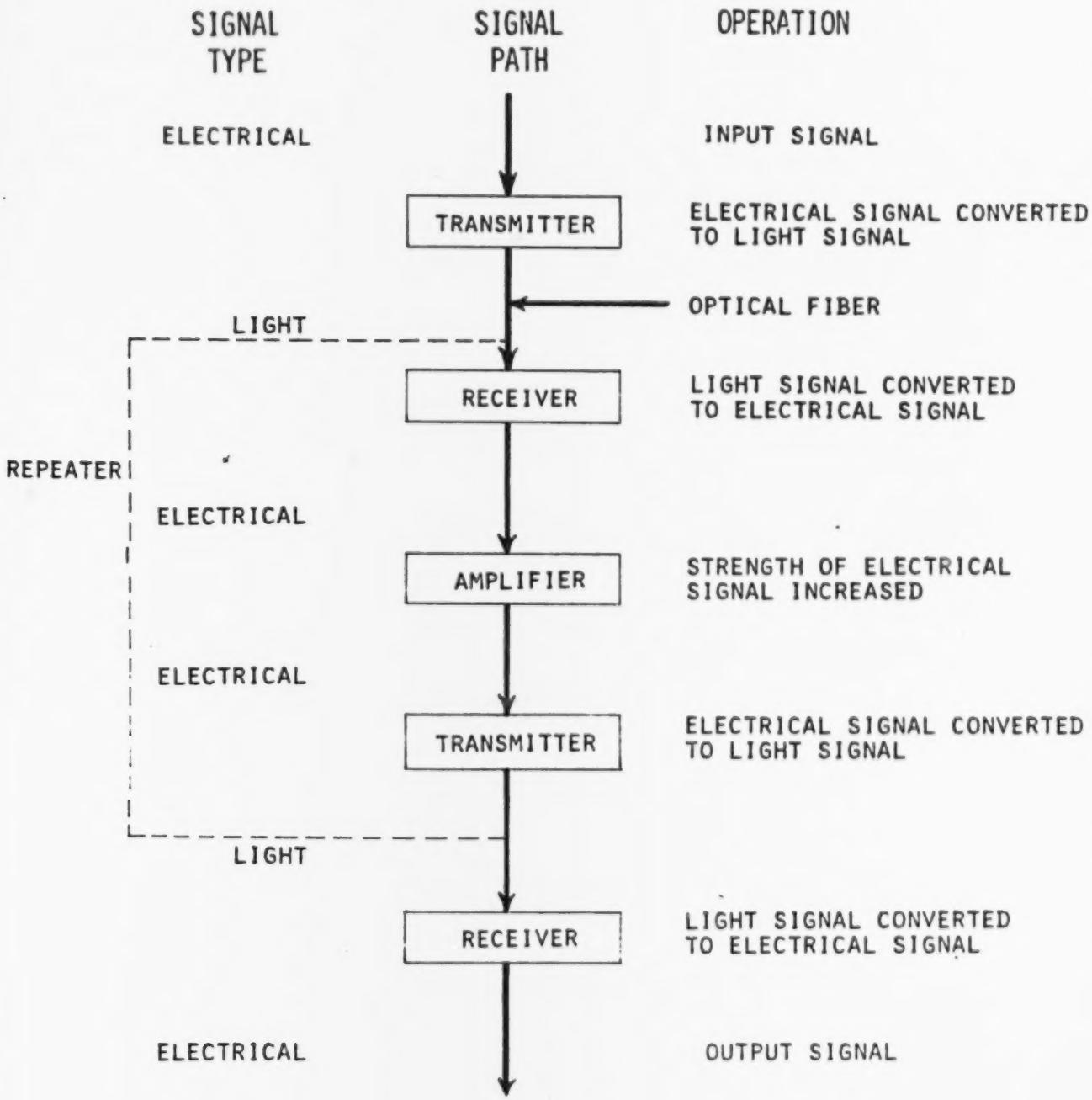

FIGURE 2

SOURCE: OFFICE OF TELECOMMUNICATIONS, INTERNATIONAL TRADE ADMINISTRATION.

Implications of accelerated activity in fiber optics production and use upon the U.S. work force are uncertain; however, Dr. William Foxler, president of the Capitol Institute of Technology, Laurel, Md., separates the work force associated with fiber optics into two categories-creational and craft. In the first, he includes those who hold degrees in optics, electrical engineering, and physics. The craft workers will install and maintain fiber optics systems. In the future, he believes demand for both kind of workers will increase. Industry sources believe that these craft workers, electronics technicians with some training in fiber optics, will find jobs waiting for them, technicians supplied by the nation's technical schools and community colleges.*

The Texas Education Agency, keeping abreast of the rapidly advancing technology, determined to examine the need in Texas for specially trained technicians to work in the growing fiber optics industry and to design a training curriculum if need does exist. Work was begun toward this end in 1984.

Purpose of the project

The purpose of the project awarded to Henderson County Junior College was to continue the development of an appropriate curriculum for the fiber optics technician.

Goals and objectives

The goal of the Fiber Optics Technician project was to examine the role of the technician in the fiber optics industry and to determine those elements necessary for a comprehensive curriculum.

In order to achieve this goal, four objectives to be accomplished were determined. The project staff were:

1. to survey current literature and current industries utilizing fiber optics technology to determine the most appropriate subject matter for the curriculum,
2. to determine, through job task analysis, the instructional objectives and activities which should be included in a fiber optics curriculum,
3. to develop an appropriate curriculum for the fiber optics technician,
4. to provide information to post secondary institutions regarding training for utilization of fiber optics in business and industry.

II. Methodology

The methodology used in carrying out each objective is outlined.

Project staff:

1) conducted a research of current literature, including ERIC, equipment manufacturers' journals,
2) identified the continuum of job tasks required for fiber optics technician,
3) analyzed needed occupational skills required through a users' survey,
4) formed an advisory committee of representatives of business/ industry technical educators, other educators, and Texas Education Agency personnel,
5) recommended an appropriate training curriculum in fiber optics,
6) suggested methods for providing services to special needs students,
7) suggested ways for utilizing computer applications in applicable areas,
8) validated all materials of the project.

LITERATURE SEARCH

The research plan was carried out in detail. The literature search was begun by staff consultant Nancy Neill at the library of Texas State Technical Institute, the major source of technical journals and papers. The library at Southern Methodist University was utilized for missing journals or articles. In addition, an on-line computer search was performed at East Texas State University in four data bases: Educational Research Information Clearinghouse (ERIC), Dissertation Abstracts, ABI/Inform (business base), and Inspec (computer data base). Documents, articles, and papers responding to the term "fiber optics" were collected and reviewed. U.S. government publications dealing with fiber optics were obtained from the Departments of Labor and Commerce.

The literature search also yielded curriculum samples and/or course outlines from several sources: industry in-house training programs; education institutions; equipment vendors; and curriculum development firms.

ADVISORY COMMITTEE

The final screening of literature was performed by Mr. Whittington for content potentially applicable to curriculum design or course content.

Concurrent with the beginning of the literature search, Mr. Whittington, assisted by Dr. Woodard, selected and nominated advisory committee members. The committee, chaired by Mr. Whittington, consisted of fifteen members, including manufacturers and users of fiber optics cables and components, representatives of two-year educational institutions, and representatives of Texas Education Agency. The complete list of committee members is attached.

The advisory committee met on two different occasions, the first on January 10, 1985. The committee was advised of the objectives of the project, of their role in

giving guidance to the project, and of the projected outcomes. the group concurred in the planned approach to conducting the project, and they discussed, in general terms, the duties of fiber optics technicians in various companies. Members also brought abundant reading material for the project staff to include in the review of literature. They also suggested sites to be visited, and several agreed to host visits to their companies.

The second committee meeting was held on March 10, 1985, at which members reviewed the proposed curriculum, making additions and rearranging some courses to ensure the proper sequence of skills development. They stressed the importance of planning a midpoint exit and of arranging courses to properly maintain student interest and curiosity. Finally, they reviewed the equipment list.

Throughout the project, the staff researcher maintained close telephone contact with members of the advisory committee, at first discussing at length the content of the task analysis form and the industry needs assessment form, and, later in the project, job characteristics, curriculum content, and equipment lists.

SITE VISITS

Site visits for staff members were arranged by three committee members for the purpose of performing task analyses and to determine work force needs. Project staff interviewed technicians working in the field, their supervisors, and personnel managers. Sites included Varo, Inc., Dallas, Optoelectronics, Garland, and Honeywell Optoelectronics, Richardson. Committee member John Anderson arranged for the staff researcher to attend a fiber optics conference in Houston sponsored by Gulf States, Inc. The conference, entitled "Fiber Optics -- Basics, Installation, and Industrial Applications," was valuable in getting a broad view of fiber optics technology and use by industry. Attendees were from across the nation and afforded an opportunity

to interview industry representatives concerning tasks and projected industry needs.

TASK ANALYSIS

The task analysis was performed to detail the various jobs which advisory committee members had tentatively suggested that fiber optics technicians perform. The analysis was an extensive one, its form patterned after one currently in use.

In order to obtain an even broader sampling of the tasks performed across many industries by fiber optics technicians, the staff researcher mailed a task analysis survey form to the advisory committee to determine its suitability for mailing to industries across Texas. The committee members reviewed the form and asked technicians to fill it out to determine its usability. As a result, the committee members recommended making the form much shorter for a general mailout. Mrs. Neill concurred with the condensed form and it was mailed to 55 selected industries. (Appendix E.)

INDUSTRY NEEDS ASSESMENT

Along with the task analysis form, an industry needs assessment was submitted to the advisory committee for its consideration. Following committee approval, the needs assessment was mailed to industries across the state.

In addition to surveying employers to determine industry manpower needs for Fiber Optics Technicians, two major manpower forecast documents were examined -- "The Occupational Outlook Quarterly," which contains employment information of major interest and relevance to those who advise students; and the Directory of Occupational Titles, which provides information on the employment outlook the next ten years.

ANALYSIS PLAN

By conducting the needed data by direct mail surveys and by on-site visits, the project staff gained three advantages: 1) information was obtained from employers first hand; 2) information was localized (peculiar to the fiber optics use in Texas); and, 3) employers became aware of the interest of T.E.A. in providing specially-trained graduates wherever possible.

The industry needs assessment was used to determine

- if industries are currently employing technicians performing fiber optics installation, testing, repairing, and troubleshooting fiber optics components and systems;
- if companies have current unfilled vacancies for Fiber Optics Technicians;
- the salary range for Fiber Optics Technicians;
- the percentage increase for Fiber Optics Technicians over the next ten years;
- a total number of Fiber Optics Technicians needed over the next five year period;
- the categories of work in which Fiber Optics Technicians would be employed;
- the company's principal endeavor.

The task analysis survey was used to determine the frequency with which currently employed technicians performed tasks either installing, operating,

maintaining, measuring, testing, performing calculations of specialized equipment. The specialized equipment includes:

- optical systems and devices
- optical testing and measuring equipment
- optical testing and measuring equipment
- electro-illumination devices
- electro-mechanical devices
- electronics devices and systems
- electronics measurement equipment
- lasers
- computers
- hand/power tools.

The survey also determined the frequency with which other tasks were performed.

- cable splicing/testing
- model fabrication
- production support/instruction
- computer programming
- technical report writing.

The accumulation of task data enabled the project staff to determine the level of pre-service education needed for job entry and job advancement -- the depth to which vocational instructors need to carry students in the various fields of study.

III. FINDINGS

The major application of fiber optics technology at the present is for telephone communications systems. The "Fiber Optics News" reports that the U.S. fiber optics marketplace for 1985 alone will be $600 million and will be spurred by competition among the various long-haul fiber optics networks under construction and by competition between the seven regional holding companies and alternative service providers.

AT&T is one of the largest long-haul providers. It plans to interconnect major population centers from Boston to Los Angeles by 1990 within its own system, using a combination of fiber optics cable, some digital microwave, and some coaxial cable. As part of that plan, it will install 1,365 sheath miles of fiber optics cable 1985. MCI recently announced announced its major network expansion plan -- a $700 million optical fiber system over the next few years to connect major metropolitan areas. It has already purchased 100,000 miles of fiber from manufacturers. By the end of 1987, Fibertrak plans to have installed an 8000-mile nationwide fiber optics network. Another industry leader, U.S. Telecom, is buying right-of-way for 23,000-mile fiber optic network for its 1985-86 construction plans.

The seven regional holding companies, not to be overpowered by the large, national networks, are taking an aggressive attitude toward installing fiber optics systems in their prescribed areas. One of those, Ameritech with its five subsidiaries, intends to spend about $88 million for its fiber requirements in 1985 and 1986.

In addition to the linking occurring across the continental United States, AT&T has begun nautical link-ups, one construction program linking the U.S. with Japan via Hawaii, another linking the Philippines with Guam. Discussions are underway to build links with Singapore, Tawain, and Korea. On the other side of the continent, FCC approval has been granted to build two fiber optics links between the United States

1982 USE BY MARKETS

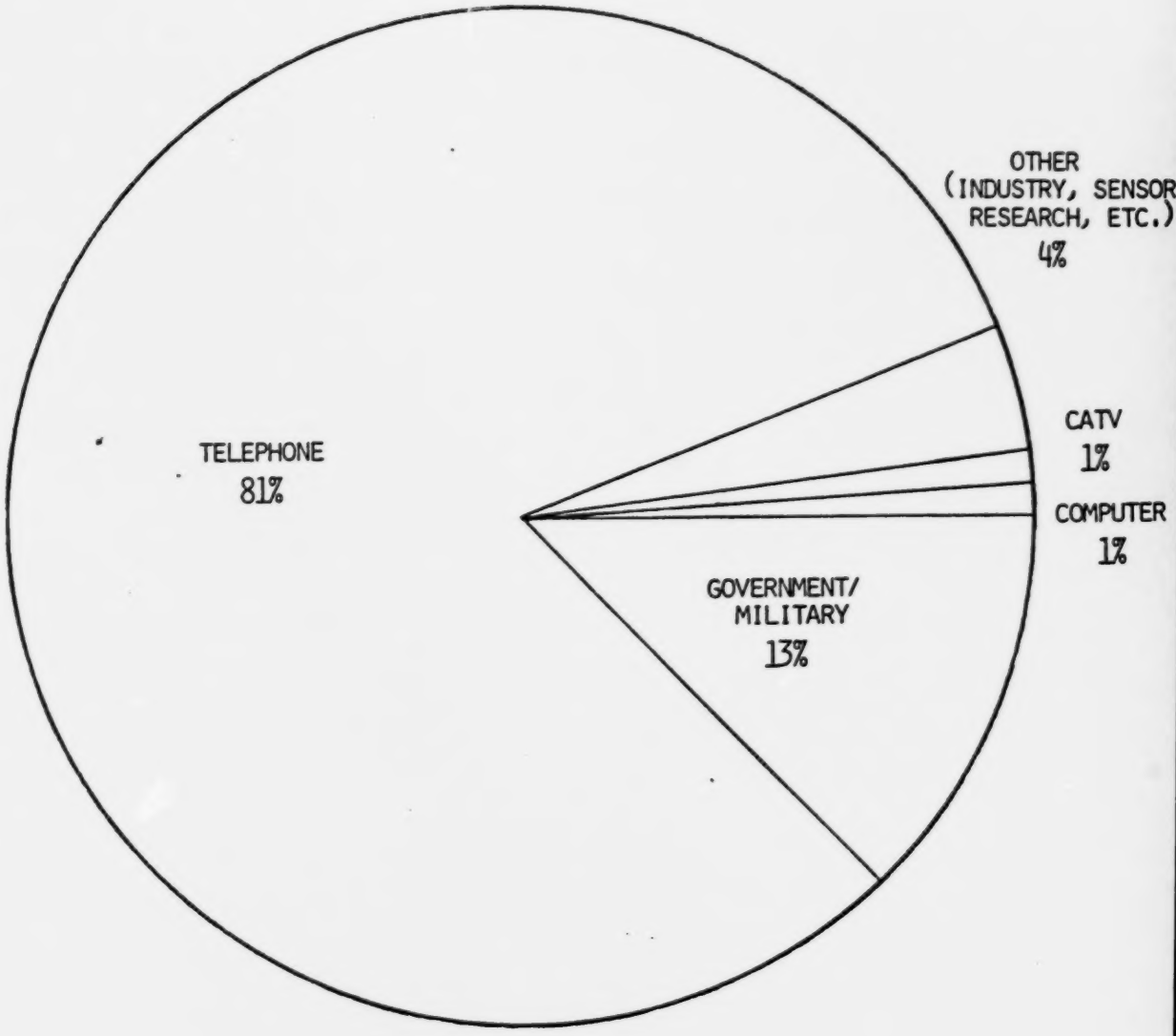

FIGURE 3

SOURCE: CORNING GLASS WORKS

OPTICAL TRANSMISSION LINES

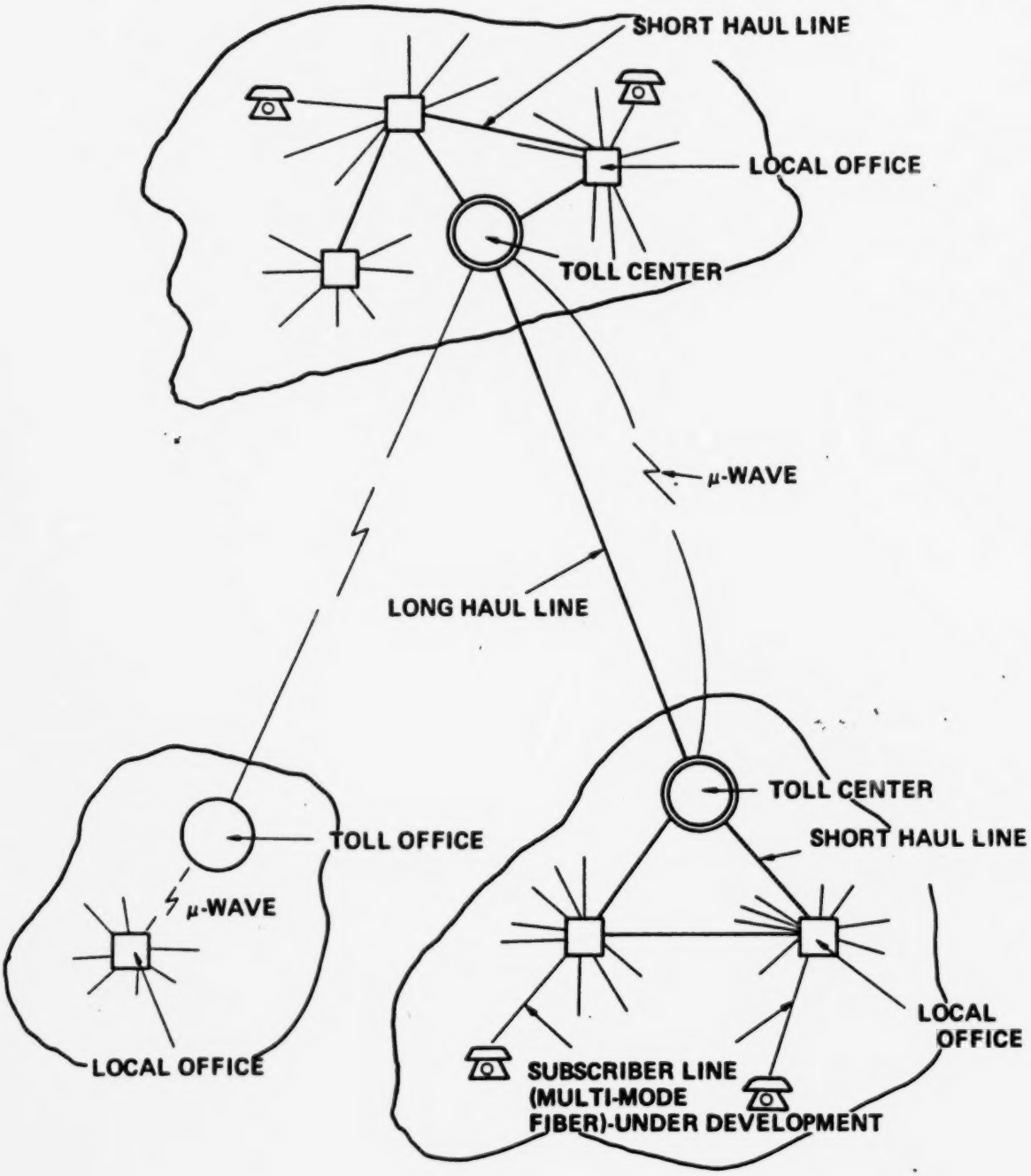

FIGURE 4

Typical Large Corporate Private Network

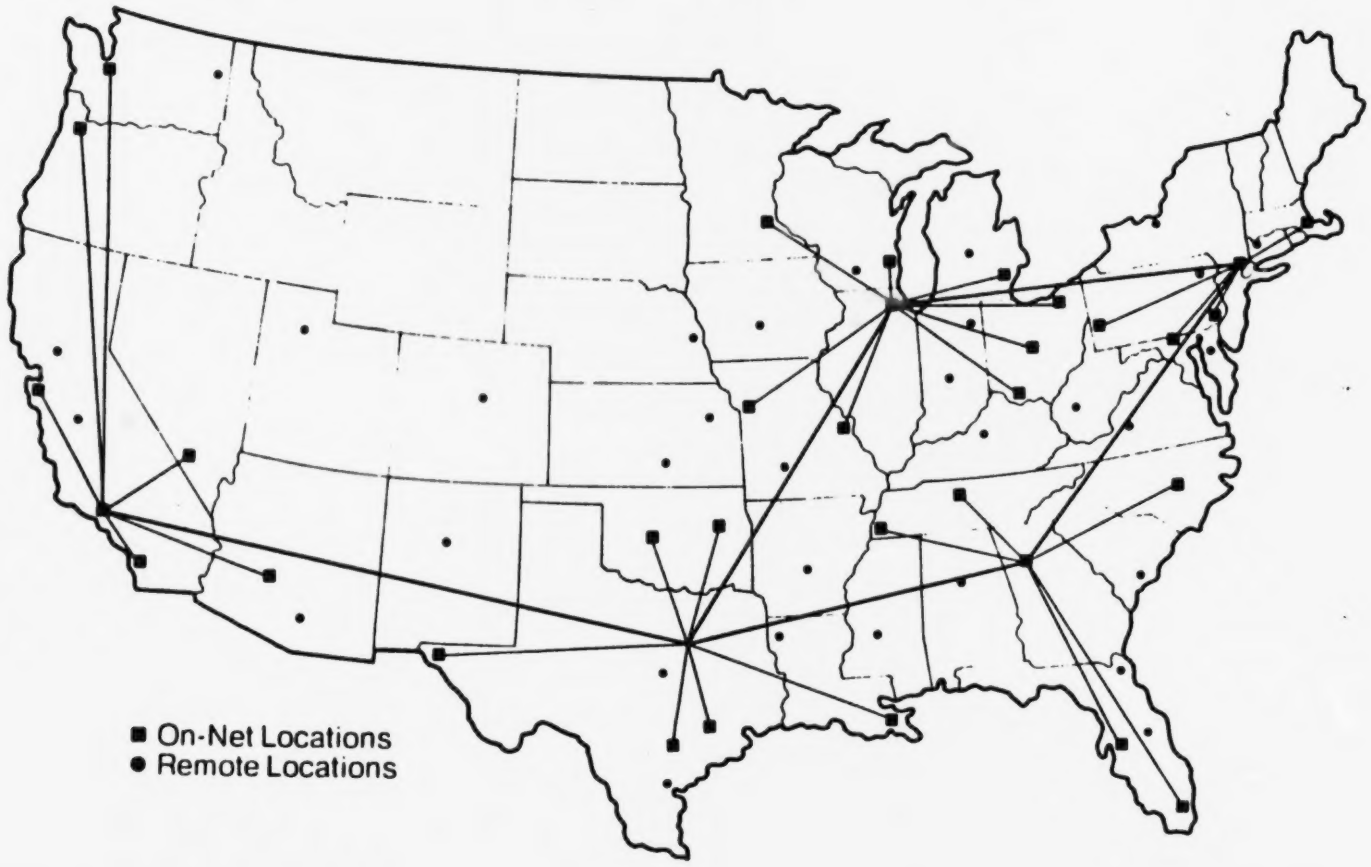

FIGURE 5

and the United Kingdom and France.

In Texas, some telecommunications links under construction or in planning stages include:

1. AT&T plans to lay cable from Sequin to San Antonio;
2. United Telecom routes include a link between Dallas and Houston,
3. GTE is connecting Dallas and Irving, with a separate route connecting Satsuma to Bryan, where optical fiber cable will interconnect with a satellite earth station;
4. LDX Net plans a Dallas-Houston link;
5. a joint venture between M-K-T Railroad and Cable & Wireless Electra intends to provide a Dallas-Houston link available October 31, 1985, with service to Fort Worth by November 30, 1985;
6. People's Communication intends to build a 200-mile fiber optics system in East Texas, interconnecting Greenville, Sulphur Springs, Tyler, Kilgore, and Longview. The group has asked the Highway Department to provide right-of-way. The expected cost of $12 to $15 million;
7. Southwestern Bell is running links in Dallas County and Collin County. Another for Electra will link to Fort Worth, Dallas, Austin, San Antonio, and Houston;
8. Gigabit is conducting a feasibility study to determine if it will construct a link between Los Angeles and Texas;
9. U.S. Telecom is constructing a route between Fort Worth and St. Louis via Kansas City, Missouri.

After telephone communications systems, the next largest application of fiber optics technology is for the Federal government, primarily the armed forces. Government spending on fiber optics is expected to reach $120 million this year. Defense applications are grouped under surveillance, target acquisition, weapons aiming, missile guidance, communications, displays and image processing, and sensing of physical qualities -- 127 current or projected systems using fiber optics.

Because of the improved cable performance, standardization of specifications, and greater availability of ancillary items, applications to the field of computers is accelerating. Although only 1 percent of fiber optics products were used for computers in 1982, research and development has perfected the transmission of voice, data, text, and images. Local area networks (LAN's) connect mainframes, or connect

Fiber Optics

Military Budget By Agency In 1985

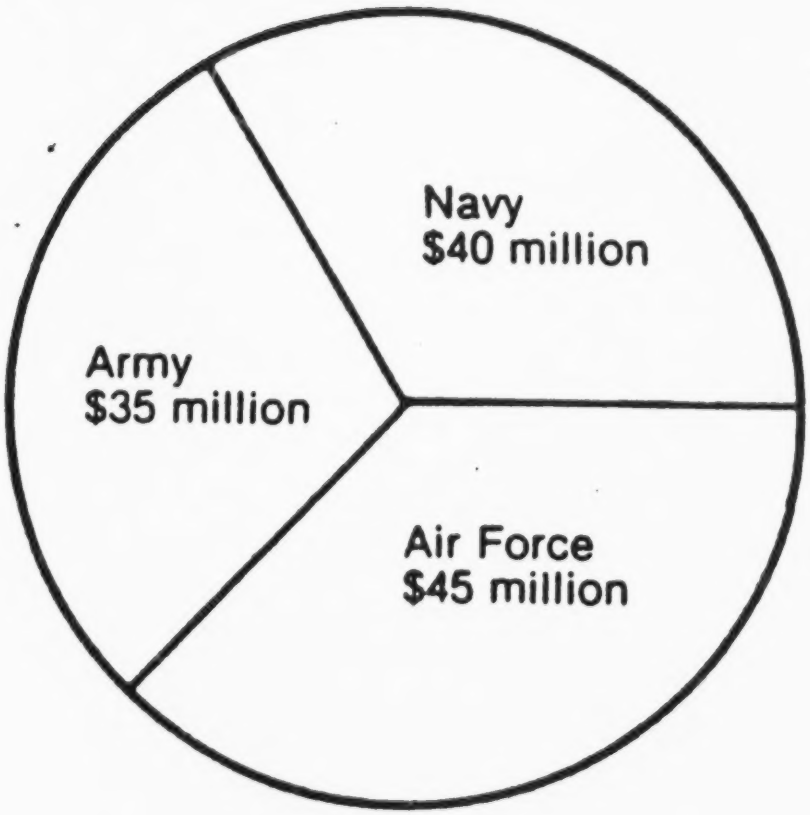

FIGURE 6

workstations to mainframes in various industries, and connects mainframes across distances for office automation. A recent use of the innovative technology is a link for The Dallas Morning News, whose downtown composing room is linked to its printing facility 25 miles away in Plano, Texas. The network enables laser facsimile equipment to communicate, thus eliminating the need for physically delivering plates or negatives to the printing facilities. The system was designed and installed by Warner-Amex, who provides ongoing service and maintenance.

To effectively tap oil reserves in the Gulf of Mexico, a 1500-mile fiber optic network has been proposed joining oil platforms 200 miles out in the Gulf of Mexico from Brownsville, Texas to Mobile, Alabama. The intent is to offer a broad range of voice, video, and data communications services, with the cable designed to withstand pressure, excessive longation, and water ingress for a planned life of 25 years. The plan is to equip 30 platforms with equipment and to interconnect with land in three locations.

The system, designed by Gulf Fibercom, will serve petroleum and related industries using the network for process control, facsimile, electronic mail, time-share operations, on-line computer operations, video conferencing, LANs, closed circuit television, supervisory control, and data acquisition.

Development in the computer industry continues to progress as optical computer devices (fiber optics being used internally) are developed. These optical computers will be used in performing specific algebraic computations at ultra-high speeds.[12]

A fourth user of fiber optics technology is cable television for transmission over long distances. Kessler Marketing Intelligence predicts that by 1992, miles of installed cable will reach 225,000 and dollar volume of the market will reach $700 million.[13] Home information centers are predicted for the 1990's, including personal computers, television and telephone signals, and videotax, possibly making fiber optics the ultimate transmission method for supplying information to the home.[14] Submarine Lightwave intends to install a fiber optics system across the Atlantic Ocean dedicated to video transmission, hoping to provide capacity for at least 144 broadcast-quality video channels or 50,000 two-way voice circuits.[15]

Atmospheric links seem to be a large untapped market for fiber optics. Atmospheric optical systems have been sold to J.C. Penney, government agencies, Metre Corp., Wisconsin and Illinois Bell, and one has already been installed between two buildings in New York City. The atmospheric optical systems will be used for videoconferencing of marketing and training sessions.[16]

Other applications of fiber optics technology include medical applications (specialized instruments to monitor oxygen, to analyze chemicals, to perform specialized surgery, and to perform exploratory examination of patients)*; industrial sensors to measure pressure, temperature, liquid levels, or airborne pollutants; sensors for process control, transportation, and manufacturing. Endoscopes used in semi-conductor manufacturing, nuclear-radiation, and automotive uses are significant areas of fiber sensor growth.

Fiber Optics Technician

Within those industries currently using fiber optics technology, technician job categories are identified by various job titles.

- cable splicer
- service technician
- engineering aid
- senior technical associate
- electro-optic technician manufacturing engineer
- optics technician
- lab technician
- laser electro-optics technician
- electronics technician

Skills And Competencies

A fiber optics technician may be called upon to perform a wide range of duties, using a broad range of skills and knowledge. He may be responsible for 1) fabrication of models from engineering specifications, 2) installation, testing, maintaining, and troubleshooting fiber optics components and devices, 3) reading and using technical publications and materials, and 4) preparing and presenting technical data.

1.) Fiber optics technicians will read, interpret and/or apply the following:
   a. block diagrams
   b. logic diagrams
   c. ladder diagrams
   d. power system diagrams
   e. electric/electronic schematics
   f. electric wiring codes
   g. blueprints
   h. charts, graphs, diagrams
   i. technical specifications
   j. technical revisions and updates
   k. technical reports and references
   l. materials, cost estimates
   m. business letters and memos

2.) The fiber optics technician will install, operate, test, maintain, modify, and/or troubleshoot the following:

   optic devices
   a. fiber optics cable
   b. photodetector
   c. radiometer
   d. total radiation pyrometer

e. optical pyrometer
f. microscope
g. interferometer
h. solid state cooler
i. electronic test equipment such as volt-ohmeter
j. oscilloscope
k. logic analyzer
l. time domain reflector
m. digital volt meter
n. digital decibel meter
o. microprocessor/circuit boards
p. programmable controller
q. spectrum analysis
r. hand tools, convention and power
s. precision measuring
t. devices

3.) The fiber optic technician will repair, maintain, and/or service:
a. driver circuits
b. connectors, splices
c. detector, repeater circuit

4.) The fiber optic technician will splice and test cable using appropriate current technology:
a. fiber cleaners or strippers
b. cleaning devices
c. cable positioner
d. fusion splicers
e. appropriate sleeve
f. splice organizer
g. rack-mounted splice organizer
h. connectors
i. appropriate test instruments

5.) The fiber optics technician will listen to, interpret, and present the following:
a. facts
b. opinions
c. explanations
d. information
e. recommendations

6.) The fiber optics technician will provide production support as needed:
a. demonstration of or aid in fabrication with production staff

Employee training

The dynamic nature of fiber optics technology, the lack of standardization of cable and components, the expensive training equipment, and lack of industry-trained instructors, to this point, have impeded the development of a uniform training program for fiber optics technicians. On-the-job training has been provided by

equipment vendors such as Celware Technologies, Inc., a major supplier of fiber optics products, and Valtec, a leader in developing field services for optical fiber systems. The training is offered to its customers at the field site or at the factory. The Valtec four-day short course includes two days in classroom instruction learning about Valtec cable, splicing procedures, and field measurements. Days 3 and 4 are spent at the customer's location with splicing being supervised by Valtec supervisors. Hewlett-Packard, Anritsu and Sumitomo training appears to be very similar, except that the training material contains basic diagrams and drawings, and manuals written in an easy-to-read format. None of the on-the-job training material contains instruction in the scientific basis of the technology.

In some cases, user companies are developing their own training programs. Lockheed has encouraged technicians to put together training packages to be taught at its Houston NASA facility. It has encouraged engineers and other interested parties to attend sessions to acquaint them with the basics of the new technology. ATT offers training at its training center in Dublin, Ohio, in a five-day course. It has graduated 500 technicians for the past three years. The graduates are all craft workers with good mechanical skills who learn fiber optics theory and practice grinding, polishing, and splicing optical fibers.

Retraining of copper cable installers and splicers is a major concern for communications labor unions, who are hoping the transition to fiber optics may not be difficult. The Connecticut Union of Telephone Workers, in cooperation with Southern New England Telephone, has instituted a week-long retraining program which stresses splicing techniques. The literature also mentions the Communications Workers of America and IBEW as concerned with retraining methods and problems.

Finally, various curriculum development and training companies (Ken Cook Education Systems and DEGEM systems are two) are marketing telecommunications training systems, advertising that the training can be adapted to various skills levels by using their modular approach.

Existing training opportunities

The literature search revealed no formal pre-service training programs specifically for fiber optics technician. In a survey of Texas community colleges, all responses were negative. T.S.T.I., Waco and Harlingen, report teaching a module on fiber optics in the Laser Electro-optic Technician program.

Texts and materials available for training fiber optics technicians include:

Allan, W. B., Fibre Optics: Theory and Practice. New York, Plenum Press, 1973.

Arnaud, Jacques A., Beam and Fiber Optics. New York, Academic Press, 1976.

Barnoski, Michael K., ed., Fundamentals of Optical Fiber Communications, 2nd ed., New York, Academic Press, 1982

Conference on the Physics of Fiber Optics, University of Rhode Island, 1978. Fiber Optics: Advances in Research and Development. New York, Plenum Press, 1979.

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Kapany, N.S., Fiber Optics: Principles and Applications. New York, Academic Press, 1967.

Kao, Charles K., Optical Fiber Systems: Technology, Design, and Applications. New York, McGraw Hill, 1982.

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Midwinter, John E., Optical Fibers for Transmission. New York, Wiley, 1979.

Miller, Steward E., ed., Optical Fiber Telecommunications. New York, Academic Press, 1979.

Seippel, Robert G., Fiber Optics. Reston, Va., Reston Publishing Co., 1984.

Seipple, Robert G., Optoelectronics. Reston, VA., Reston Publishing Co., 1981.

Wolfe, Helmut F., Handbook of Fiber Optics: Theory and Applications. New York, Garland Publishers, 1980.

Incidental information which points up the need for a comprehensive

well-designed textbook for technician training, - the T.S.T.I. - Waco instructor uses parts of four different books because none contains complete, state-of-the-art information; the Wolfe book (only one of the several needed) sells for $62.50; the Barnoski book is written at grade level 14.

Equipment and systems vendors are preparing and distributing handbooks to serve, not as engineering aids, but to provide the basis of the technology to users and designers of systems. These handbooks must be noted because they appear to be widely read and used (TSTI-Waco uses the AMP in class), and they are written from the practical, as opposed to theoretical, view.

Sterling, Donald and AMP staff. Designers Guide to Fiber Optics. Harrisburg, Pa., AMP, Inc., 1982.

Fiber Optics Dept., Innovator. Geneva, Ill., Belden Fiber Optics, 1979.

Pifox Fiber Optics Cables, ed., Designer's Guide to Fiber Optics. Cahners Publishing Company.

Special needs students

For special needs students who may be entering a fiber optics technician program, there are some special helps available.

Electronics training equipment can be modified for visually impaired, LLD (language learning disabled), and motor impaired students. A talking adaptor adds speech to electronic systems and equipment. The adaptor interfaces easily with most devices that have digital displays or external digital outputs. It is available from Sensory Interface Equipment, Inc., 4442 Kasson, Syracuse, NY 13215. Other pieces of specially adapted electronics training equipment include:

Audible meter reader
Auditory oscilloscope
Auditory volume level indicator
Sipson multimeter
Talking frequency counter
Talking meter
Talking multimeter
Tape head alignment system

Computer equipment has an expanded keyboard for motor-impaired students, voice input modules, and a text-to-speech converter.

Computer-assisted instruction material could be prepared with the aid of a "Speak Easy" to tutor students who have difficulty learning. The "Speak Easy" vocalizes data displayed on the video screen. The student hears the keyboard entry before sending it to the host computer, hears the response, hears the display in as much or as little detail as needed. Simple commands, instructions could be read to the student line or as a whole display. Specialized vocabulary numbers could be spelled out.

Equipment such as this would be especially helpful to poor readers, LLD, or slow learners who would benefit from multi-sensory instruction. The voice information would cut down on errors by reinforcing visual information with audible clues.

Although there are no prices listed, this specialized equipment and purchase information are listed in Tools, Equipment, and Machinery Supplement: Adapted for the Vocational Education and Employment People, published by the Vocational Studies Center, University of Wisconsin - Madison.

Future Needs

In determining the future needs for persons trained specifically as Fiber Optics Technicians, the research project designed and mailed the questionnaire in Appendix A. There was a twenty-nine percent (29%) response rate from Texas businesses and industry. Of the total number of questionnaires returned, fifty percent (50%) indicated that they do not presently use Fiber Optics Technicians, but plan to do so sometime in the future. Only two forms reported having unfilled vacancies for specifically trained Fiber Optics Technicians.

Following is a tabulation of responses from major fiber optics users in Texas, indicating their current and projected employment numbers. Although numbers are small, there appears to be a fifty-six (56%) increase between the projected needs between 1985 and 1990.

	1985	1986	1987	1988	1989	1990
ITT	30	40	50	60	70	70
Northern Telecom	5	5	10	10	10	20
Western Geophysical	4	5	5	5	5	5
Texas Eastern Transmission	0	0	2	6	6	0
Intecom	3	4	4	4	5	6
Fotec	5	5	5	5	5	5

Comments from respondents concerning their individual needs are as follows:

> ITT - Coursework should include the "chemistry" of fiber manufacturing processes and the principles of glass fracture mechanics. Many technicians work directly with glass in the fiber manufacturing process and in the splicing field repair area.

Northern Telecom-Fiber. - Integrated optics is a rapidly expanding field and colleges which emphasize such training will benefit future graduates. However, the number of companies is presently still small so relocation is necessary.

Western Geophysical Company - Knowledge of semiconductor light sources LEDs, PIN detectors and basic electronics.

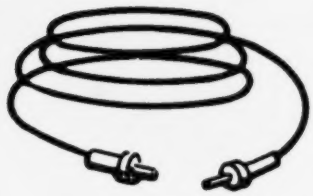
Amoco Chemicals Corporation - Industrial need differs quite a bit from the telecommunications area. Reliable data transmission is only a small part of what we require from a fiber optic system. Until such time as 'primary' sensing elements or transducers can be developed that will interface directly with fiber optics (and not require an external power source), very little acceptance will be made.

When this time arrives, industry will rely on existing I & E technicians. They will be expected to pick up fiber optic techniques via seminars or training courses and they will be expected to use conventional installation tools in the field to modify/install equipment. Can't, at this time, see many industrial firms being able to afford to hire this specialized an individual. The task will have to be shared with conventional technician abilities.

I am glad you are staying up with current state of the art technology and planning for future trade needs.

Intecom, Incorporated - Currently our Field Engineers and electronic technicians trouble-shoot and maintain FO. It would be extremely advantageous to have this specialized training available to them in order to supplement OJT.

FIBER OPTICS



APPENDICES

APPENDIX A

Survey questionnaire to determine your requirements for

FIBER-OPTICS TECHNICIANS

I. Name of company, institution, or government division:

_____

_____

Definitions: Technician - A person engaged in work requiring knowledge of physical, life, engineering and mathematical sciences comparable to knowledge acquired through technical institutes, junior colleges, or other formal post-high school training, or through equivalent on-job training or experience.

Technician - Person trained in the techniques of installing, maintaining, testing, repairing, and troubleshooting of fiber optics components and system.

1. _____Yes_____No Does your company (or division) currently employ technicians of any type? If so, approximately how many? _____

2. _____Yes_____No Do you feel that the field of light and optics needs specially trained technicians such as the Fiber-Optics Technician?

3. _____Yes_____No Does your company (or division) currently employ technicians that could be classified as Fiber-Optics Technician (FOT)? If so how many? _____

4. _____Yes_____No Do you have current unfilled vacancies for FOT? If so, how many? _____

5. Please indicate the typical beginning salary a FOT graduate might expect to receive in your company.

a) $701-800/mo. _____ d) $1001-1100/mo. _____
b) $801-900/mo. _____ e) $1101-1200/mo. _____
c) $901-1000/mo. _____ f) Greater than $1200/mo. _____

6. In your opinion, will your need for FOT/s, during the next ten years

_____ decrease _____ increase 26-50%
_____ remain same _____ increase by 51-75%
_____ increase by 0-25% _____ increase 76-100% or more

7. Can you give an estimate of the total number of FOT's you will need in the next 5 year period.

1985 _____ 1988 _____
1986 _____ 1989 _____
1987 _____ 1990 _____

8. If you have future need for an FOT, would you prefer to hire a technician

a) _____ whose entire two-year technical education was devoted toward training as an electronics technician following which you would provide on-the-job-FOT training, or

b) _____ whose two-year course of study included special training in lasers, conventional light and optics and electro-optics with attendent sacrifice of electronics training?

9. Please check those items in which you would think a FOT should receive speciality training.

_____ fiber optics
_____ lasers
_____ optical elements (lenses, prisms ...etc.)
_____ electro-optical devices
_____ optical sensors and transducers
_____ conventional (visible) light sources and detectors
_____ ultra-violet light sources and detectors
_____ photography
_____ electronics
_____ optical materials and handling
_____ holography
_____ facsimile and printing
_____ light modulation
_____ safety and OSHA
_____ infrared light sources and detectors
_____ interferometry
_____ report writing
_____ computer basics
_____ thinfilms and coating
_____ sales methods and techniques
_____ conventional optics (geometrical and wave optics)
_____ other (specify) _____
_____
_____

10. Please check the type(s) of work in which you would use a Fiber-Optic Technician

_____ in-plant product development and design
_____ in-plant manufacturing
_____ in-plant product checking, testing or quality control
_____ in-plant equipment maintenance and repair
_____ outside-plant sales and/or service and repair
_____ outside-plant customer equipment installation
_____ other (specify) _____

11. Please indicate the probable supervision situation(s) in which a newly employed FOT in your plant (after an initial training period) would be placed.

_____ no close direct supervision
_____ supervised by senior technician or engineering aide
_____ supervised by an engineer, physicist or other scientist
_____ supervised by senior sales personnel
_____ supervised by senior service personnel
_____ supervised by a manufacturing supervisor
_____ other (specify) _____

12. Would you classify your company's principal endeavor as
_____ primarily research
_____ primarily product or system research and development with little or no manufacturing
_____ research, development and manufacturing
_____ almost solely manufacturing
_____ other (specify) _____

13. _____Yes_____No Is your company currently producting and marketing or have they announced the production and marketing of any equipment incorporating lasers, light, or optical systems using fiber optics as a fundamental component?

14. _____Yes_____No Does your company use instruments and equipment incorporating lasers, light or optical systems, or fiber optics in quantities which require a trained technician for operation or maintenance?

15. If the answer to either 12 or 13 is yes please check the classification(s) below in which these products, instruments or equipment fall.

_____ precision lineal measurement
_____ displacement or velocity measurement
_____ positioning or control devices
_____ gauging devices
_____ micro-machining equipment (e.g. drilling, welding, etc.)
_____ geodetic instruments
_____ simulation
_____ data storage
_____ data retrieval
_____ computing
_____ medical appartus
_____ optical readers or scanners
_____ communications (e.g. voice, TV and telemetry links)
_____ navigation
_____ information display
_____ data display (alphanumeric or graphical)
_____ pictoral display (including holography)
_____ radar or range finding
_____ other (specify)_____
_____
_____

16. Comments: Please include any additional information which you feel would help us identify the need in numbers and competencies for FOT.

_____

_____

_____

_____

_____

_____

17. Would this course content be suitable to retrain or upgrade present employees?

_____

_____

_____

_____

18. _____Yes_____No Would you like to receive a copy of the report summarizing the results of this survey?
Please mail to: _____
_____
_____
_____

APPENDIX B

Equipment List

Fiber Optics Technician

Fiber optics

- Optical power meters/connectors/hookups
- Optical fiber tester
- Optical tester
- Optical spectrum analyzer
- Optical time domain reflectometer
- E/O converters
- O/E converters
- Optical fiber transmission measuring system
- Waveform monitors
- Optical key box
- Optical attenuators
- Optical branch/coupline
- Optical accessories (cutters,strippers, scramblers,etc.)
- Radiometer
- Photometer
- Multimeter
- Cable
- Connector/fiber hookup to LED sources
- Hookups to unterminated fiber
- Fiber optic multimeter
- Chopped light meter
- Sensors
- Power Source/interface
- Adaptors
- Transmitters
- Receivers
- Optical data link
- Fiber optic flow meter
- Detector/interface
- Oscilloscope
- Worktable
- Splice organizer
- Fan out kit
- Pigtail organizer
- Fusion splicer
- Optical level meter
- Repeater

Geometric optics

Student measuring microscope
Viewing telescope
Drafting table
Drafting machine
Collimator

Wave optics

X-Y translation stage
Power supply for arc lamp
Optical flat
Rotating table

Electro-optic devices

Acousto-optic modulator with driver
Electro-optic modulator and receiver
Beam expander/collimator
Autocollimator, pinhole type
Single lens reflex camera, 35 mm
Laser beam director
Rotating mirror, with motor
Precision pinhole set
Holography system
Photomultiplier
Photomultiplier power supply
Nose cone assembly for IR lens
Corner cube reflector, 1" dia. accuracy
Corner cube reflector, 3" dia. accuracy
AC-DC inverter
Laser line filter
Galvanometric laser beam scanner
Mounting head for scanner
Driver/amplifier for beam scanner
Linear translator
Spectroscope

Equipment List
DEGEM Training Station

Course	Type of Equipment	1985 Unit Cost	Quantity Required	Total Cost
	Communications Training System Technical Laboratory System, consisting of two units:			$4,300

1. OPCOM 1/1 Optical LED Transmitter, includes:

   * logic interface between TTL & LED driver
   * 20 MH LED driver
   * Visible light LED
   * Infra-red LED
   * Optical connectors
   * Special types of LEDs (optional)
   * LED current control

2. OPCOM 1/2 Optical PIN Diode Receiver Unit, includes:

   * electrical high frequency transimpedance receiver
   * PIN photo diode for fiber optic systems
   * linear amplifier
   * output connector for optical power measurements
   * optical connectors

3. Required accessories for the two units:

   * master board, DEGEM MB2F
   * patching cords, DEGEM DL-2
   * pulse generator, DEGEM PU-221
   * fiber optic cables, DEGEM TCFF 3/A

4. Opcom service unit, PU-254, specially designed test instruments for the OPCOM systems to provide:

   * 8-bit data sequence generator
   * 8 switches for above
   * clock generator
   * error rate meter
   * internal self-check
   * option for eternal equipment

   20 MH dual trace oscilliscope
   Multimeter
   Current probe
   Power meter
   Photodyne with connector

If a school elects not to purchase a training station, the following items will be necessary:

Fiber optics

- Optical power meters/connectors/hookups
- Optical fiber tester
- Optical spectrum analyzer
- Optical time domain reflectometer
- Optical fiber transmission measuring system
- Optical attenuators
- Photometer
- Multimeter
- Cable
- Connector/fiber hookup to LED sources
- Sensors
- Power source/interface
- Adaptors
- Transmitters
- Receivers
- Optical data link
- Detector/interface
- Oscilloscope
- Worktable
- Splice organizer
- Fusion splicer

Geometric optics

- Student measuring microscope
- Viewing telescope
- Drafting table
- Drafting machine
- Collimator

Wave optics

- X-Y translation stage
- Power supply for arc lamp
- Optical flat
- Rotating table

Electro-optic devices

- Electro-optic modulator and receiver
- Beam expander/collimator
- Autocollimator, pinhole type

APPENDIX C

List of Manufacturers

CABLES

Air Logistics Corp.
3600 E. Foothill Blvd.
Pasadena, CA 91109
(213) 795-9971

American Fiber Optics Corp.
1198 East Willow St.
Signal Hill, CA 90806
(213) 595-8797

Andrew Corp.
10500 W. 153rd St.
Orlando Park, IL 60462
(312) 349-3300

Applied Fiberoptics Inc.
East Main St.
Southbridge, MA 01550
(617) 765-9121

Artel Communications Corp.
P. O. Box 100
West Side Station
Worcester, MA 01602
(617) 752-5690

BIW Cable Systems Inc.
65 Bay St.
Boston, MA 02125
(617) 265-2102

Belden Corp.
Fiber Optics Group
2000 S. Batavia Ave.
Geneva, IL 60134
(312) 232-8900

Brand-Rex Co.
Electronic & Industrial Div.
P. O. Box 498
Willimantic, CT 06226
(203) 423-7771

Corning Glass Works
Telecommunication Products Dept.
Baron Steuban Place
Corning, NY 14831
(607) 974-4411

E. I. du Pont de Nemours & Co.
Wilmington, DE 19898
(302) 774-1000

Ensign-Bickford Industries, Inc.
660 Hopemeadow St.
Simsbury, CT 06070
(203) 658-4411

[redacted]Tec Corp.
200 Frontage Rd.
West Haven, CT 06516
(203) 934-7961

Fiberguide Industries Inc.
[redacted]119 Park Ave.
Summit, NJ 07901
(201) 522-1877

[redacted]beroptic Cable Corp.
2931 N. Poinciana Blvd.
Kissimmee, FL 32741
(305) 422-2662

Fiberoptics Laboratories Inc.
[redacted]P. O. Box 225
Sturbridge, MA 01566
(617) 347-9521

[redacted]beroptics Technology Inc.
Quassett Rd. or 1 Fiber Rd.
Pomfret, CT 06258
(203) 928-0443

Fiber Optics Development Sys. Inc.
[redacted]427 Olive St.
Santa Barbara, CA 93101
(805) 965-2589

[redacted]rt Fiber Optics Inc.
P. O. Box 1082
Somerville, NJ 08876
(201) 231-0400

Galieleo Electro-Optics Corp.
[redacted]Galileo Park
Sturbridge, MA 01518
(617) 347-9191

[redacted]ndalf Data Inc.
1019 South Noel
Wheeling, IL 60090
(312) 541-6060

[redacted]

[redacted]

General Cable Co.
Fiber Optics Div.
(GK Technologies Inc.)
160 Fieldcrest Ave.
Raritan Center
Edison, NJ 08837
(201) 225-4780

General Fiber Optics Inc.
P. O. Box 82
Caldwell, NJ 07006
(201) 228-4400

Lenox Instrument co.
111 E. Luray
Philadelphia, PA 19120
(215) 324-4543

Lightwave Technologies Inc.
5737 Valjean Ave.
Van Nuys, CA 91406
(213) 786-7873

Mitchida America Inc.
65 Oak St.
Norwood, NJ 07648
(201) 767-7350

Math Associates Inc.
6 Manhasset Ave.
Port Washington, NY 11050
(516) 944-7050

Moklight Fiber Optics Div.
(Raychem Corp.)
3035 N. 33rd Dr.
Phoenix, AZ 85017
(602) 269-8387

NSG America Inc.
(Nippon Sheet Glass Co. Ltd.)
136 Central Ave.
Clark, NJ 07066
(201) 499-0939

Optelecom Inc.
15940 Luaanne Dr.
Gaithersburg, MD 20877
(301) 948-4232

Pilo Electron Inc.
Optical Systems Div.
530 Boston Turnpike
Shrewsbury, MA 01545
(617) 845-5000

Pirelli Cable Corp.
Special Cable Div.
2 Tower Dr.
P. O. Box 50
Wallighford, CT 06492
(203) 265-7126 or
(800) 243-3959

imes Fiber Communications Inc.
358 Hall Ave.
P. O. Box 384
Wallingford, CT 06492
(203) 265-8500

Valtec
(a Phillips-M/A Com venture)
99 Hartwell St.
W. Boylston, MA 01583
(617) 835-6082

Vector Cable
(Schlumberger Technology Corp.)
555 Industrial Rd.
Sugarland, Tx 77478
(713) 491-9196

elch Allyn Inc.
Jordan Rd.
Skaneateles Falls, NY 13153
(315) 685-8351

INKS

AEF - Felefunken
Electrical & Electronic Components
Rt. 22 & Orr Dr.
Somerville, NJ 08876

rtel Communications Corp.
P. O. Box 100
West Side Station
Worcester, MA 01602
(617) 752-5690

ugat Inc.
Augat Fiberoptics
40 Perry Ave.
Attleboro, MA 02703
(617) 222-2202

Burr-Brown Research Corp.
6730 S. Tucson Blvd.
Tucson, AZ 85706
(602) 746-1111

Canoga Data Systems
(div. of Perkins Research &
Manufacturing Inc.)
21218 Vanowen
Canoga Park, CA 93063
(213) 888-2003

Codenoll Technology Corp.
1086 N. Broadway
Yonkers, NY 10701
(914) 965-6300

Fairchild Camera & Instrument
Optoelectronics Div.
3105 Alfred St.
Santa Clara, CA 95050
(408) 987-9200

Fort Fiber Optics Inc.
P. O. Box 1082
Somerville, NJ 08876
(201) 231-0400

Gandalf Data Inc.
1019 South Noel
Wheeling, IL 60090
(312) 541-6060

General Optronics
3005 Hadley Rd.
S. Plainfield, NJ 07080
(201) 753-6700

Hewlett-Packard
Optoelectronics Div.
640 Page Mill Rd.
Palo Alto, CA 94304
Telex 910-373-1247

Honeywell Inc.
Optoelectronics Div.
830 E. Arapaho Rd.
Richardson, Tx 75081
(214) 234-4271

ITT Croy Fiberoptic Systems Div.
700 S. Main St.
Spring Valley, NY 10977
(914) 425-2000

Lightwave Communications Inc.
(Harbor Electronics)
650 Danbury Rd.
Ridgefield, CT 06877
(203) 438-3591

Manage Inc.
40 Nichols Rd.
Chicopee, MA 01013
(413) 592-3834

ath Associates Inc.
6 Manhasset Ave.
Port Washington, NY 11050
(516) 944-7050

Meret Inc.
1815 24th St.
Santa Monica, CA 90404
(213) 828-7496

otorola Inc.
Semiconductor Group
5005 E. McDowell Rd.
Phoenix, AZ 85008
(602) 244-6900

National Semiconductor Corp.
2900 Semiconductor Dr.
Santa Clara, CA 95051
(408) 737-5000

ptical Communications Corp.
950 Norwood Rd.
Silver Spring, MD 20904
(301) 924-2800

Optical Information Systems
350 Executive Blvd.
Elmsford, NY 10523
(914) 345-5850

halo Electron Inc.
Optical Systems Div.
9240 Deering Ave.
Chatsworth, CA 91311
(213) 998-3177

lessey Optoelectronics & Microwave Lts.
Wood Burcote Way
Towcester, Northants, UK
US Office:
1641 Kaiser Ave.
Irvine, CA 92714
(714) 540-9934

RCA Corp.
Electro Optics & Devices
New Holland Ave.
Lancaster, PA 17604
(717) 397-7661

Versitron Inc.
6310 Chillum PINW
Washington, DC 20011
(202) 882-8464

RECEIVERS AND TRANSMITTERS

EG - Telefunken
Electrical & Electronic Components
Rt. 22 & Orr Dr.
Somerville, NJ 08876
(201) 722-9800

Artel Communications Corp.
P. O. Box 100
West Side Station
Worcester, MA 01602
(617) 752-5690

Beckman Instruments
2500 Harbor Blvd.
Fullerton, CA 92634
(714) 871-4848

elden Corp.
Fiber Optics Group
2000 S. Batavia Ave.
Geneva, IL 60134
(312) 232-8900

Canoga Data Systems
(div. of Perkins Research
& Manufacturing Inc.)
21218 Vanowen
Canoga Park, CA 93063
(213) 888-2003

Codenoll Technology Corp.
1086 N. Broadway
Yonkers, NY 10701
(914) 965-6300

DTec Corp.
200 Frontage Rd.
West Haven, CT 06516
(203) 934-7961/9

Fairchild Camera & Instrument
Optoelectronics Div.
3105 Alfred St.
Santa Clara, CA 95050
(408) 987-9200

Fort Fiber Optics Inc.
P. O. Box 1082
Somerville, NJ 08876
(201) 231-0400

General Electric Co.
Semiconductor Products Dept.
W. Genessee St.
Auburn, NY 13021
(315) 253-7321

General Optronics
3005 Hadley Rd.
S. Plainfield, NJ 07080
(201) 753-6700

Honeywell Inc.
Optoelectronics Div.
830 E. Arapaho Rd.
Richardson, Tx 75081
(214) 234-4271

International Telephone & Telegraph Corp.
Electro-Optical Products Div.
7635 Plantation Rd.
P. O. Box 7065
Roanoke, VA 24019
(703) 563-0371

Laser Diode Laboratories
(A M/A Com Co.)
1130 Somerset St.
New Brunswick, NY 08901
(201) 249-7000

Lasertron Inc.
37 North Ave.
Burlington, MA 01803
(617) 272-6650

Lightwave Communications Inc.
(Harbor Electronics)
650 Danbury Rd.
Ridgefield, CT 06877
(203) 438-3591

Lumage Inc.
40 Nichols Rd.
Chicopee, MA 01013
(413) 592-3834

Math Associates Inc.
6 Manhasset Ave.
Port Washington, NY 01013
(516) 944-7050

Motorola Inc.
Semiconductor Group
5005 E. McDowell Rd.
Phoenix, AZ 85008
(602) 244-6900

NSG America Inc.
(Nippon Sheet Glass Co. Ltd.)
136 Central Ave.
Clark, NJ 07066
(201) 499-0939

National Semiconductor Corp.
2900 Semiconductor Dr.
Santa Clara, CA 95051
(408) 737-5000

Optical Communications Corp.
950 Norwood Rd.
Silver Spring, MD 20904
(301) 924-2800

Optical Information Systems
350 Executive Blvd.
Elmsford, NY 10523
(914) 345-5850

Optronics Ltd.
Fibre Optics Div.
Cambridge Science Park
Milton Rd.
Cambridge, England CB4 4BH
(0223) 64364

Phalo Electron Inc.
Optical Systems Div.
9240 Deering Ave.
Chatsworth, CA 91311
(213) 998-3177

RCA Corp.
Electro Optics & Devices
New Holland Ave.
Lancaster, PA 17604
(717) 397-7661

Raytheon Data Systems Co.
Telecommunications
159 Morse St.
Norwood, MA 02062
(617) 762-6700

RW, Optron
1201 Tappan Circle
Carrollton, Tx 75006
(214) 323-2200

Times Fiber Communications Inc.
358 Hall Ave.
P. O. Box 384
Wallingford, CT 06492
(203) 265-8500

SEMICONDUCTOR DETECTORS

EG - Telefunken
Electrical & Electronic Components
Rt. 22 & Orr Dr.
Somerville, NJ 08876
(201) 722-9800

born Electronics
1928C Old Middlefield Rd.
Mountain View, CA 94043
(415) 967-6350

Codenoll Technology Corp.
1086 N. Broadway
Yonkers, NY 10701
(914) 965-6300

airchild Camera & Instrument
Optoelectronics Div.
3105 Alfred St.
Santa Clara, CA 95050
(408) 987-9200

General Electric Co.
Semiconductor Products Dept.
W. Genessee St.
Auburn, NY 13021
(315) 253-7321

Honeywell Inc.
Optoelectronics Div.
830 E. Arapaho Rd.
Richardson, Tx 75081
(214) 234-4271

udson Infrared Inc.
21 Commerce Dr.
Montgomeryville, PA 18936
(215) 368-6900

Laser Diode Laboratories
(A M/A Com Co.)
1130 Somerset St.
New Brunswick, NY 08901
(201) 249-7000

Math Associates Inc.
6 Manhasset Ave.
Port Washington, NY 01013
(516) 944-7050

Maret Inc.
1815 24th St.
Santa Monica, CA 90404
(213) 828-7496

Mitsubishi Electronics America Inc.
Semiconductor Div.
1230 Oakmead Parkway
Sunnyvale, CA 94086
(213) 637-6246

Motorola Inc.
Semiconductor Group
5005 E. McDowell Rd.
Phoenix, AZ 85008
(602) 244-6900

Plessey Optoelectronics & Microwave Lts.
Wood Burcote Way
Towcester, Northants, UK
US Office:
1641 Kaiser Ave.
Irvine, CA 92714
(714) 540-9934

Texas Instruments Inc.
13500 N. Central Expwy.
Dallas, Tx 76265
(214) 995-4422

SEMICONDUCTOR LASERS

AEG - Telefunken
Electrical & Electronic Components
Rt. 22 & Orr Dr.
Somerville, NJ 08876
(201) 722-9800

Codenoll Technology Corp.
1086 N. Broadway
Yonkers, NY 10701
(914) 965-6300

General Optronics
3005 Hadley Rd.
S. Plainfield, NJ 07080
(201) 753-6700

Hitachi America Ltd.
1800 Bering Dr.
San Jose, CA 95112
(408) 292-6404

ser Diode Laboratories
(A M/A Com Co.)
1130 Somerset St.
New Brunswick, NY 08901
(201) 249-7000

sertron Inc.
37 North Ave.
Burlington, MA 01803
(617) 272-6650

tsubishi Electronics America Inc.
Semiconductor Div.
1230 Oakmead Parkway
Sunnyvale, CA 94086
(213) 637-6246

C Electronics USA
(Electron Div.)
252 Humboldt Court
Sunnyvale, CA 94086
(408) 745-6520

tical Information Systems
350 Executive Blvd.
Elmsford, NY 10523
(914) 345-5850

CA Corp.
Electro Optics & Devices
New Holland Ave.
Lancaster, PA 17604
(717) 397-7661

ED's

born Electronics
1928C Old Middlefield Rd.
Mountain View, CA 94043
(415) 967-6350

Codenoll Technology Corp.
1086 N. Broadway
Yonkers, NY 10701
(914) 965-6300

airchild Camera & Instrument
Optoelectronics Div.
3105 Alfred St.
Santa Clara, CA 95050
(408) 987-9200

General Electric Co.
Semiconductor Products Dept.
E. Genessee St.
Auburn, NY 13021
(315) 253-7321

Hitachi America Ltd.
1800 Bering Dr.
San Jose, CA 95112
(408) 292-6404

Honeywell Inc.
Optoelectronics Div.
830 E. Arapaho Rd.
Richardson, Tx 75081
(214) 234-4271

Huber & Suhner & Co.
24, Degersheimerstr
CH-9100 Herisau, Switzerland
0041 71 53 15 15

Laser Diode Laboratories
(A M/A Com Co.)
1130 Somerset St.
New Brunswick, NY 08901
(201) 249-7000

Lasertron Inc.
37 North Ave.
Burlington, MA 01803
(617) 272-6650

Mitec Inc.
1815 24th St.
Santa Monica, CA 90404
(213) 828-7496

Mitsubishi Electronics America Inc.
Semiconductor Div.
1230 Oakmead Parkway
Sunnyvale, CA 94086
(213) 637-6246

Motorola Inc.
Semiconductor Group
5005 E. McDowell Rd.
Phoenix, AZ 85008
(602) 244-6900

Plessey Optoelectronics & Microwave Lts.
Wood Burcote Way
Towcester, Northants, UK
US Office:
1641 Kaiser Ave.
Irvine, CA 92714
(714) 540-9934

RCA Corp.
Electro Optics & Devices
New Holland Ave.
Lancaster, PA 17604
(717) 397-7661

TRW, Optron
1201 Tappan Circle
Carrollton, Tx 75006
(214) 323-2200

1st Quarterly Report
Fiber Optics Technician
Curriculum Research Project

of the

Research Coordinating Unit
Texas Education Agency
201 E. 11th Street
Austin, Texas 78701

(512) 834-4165

by

Herschel K. Whittington
Project Director

Office of Institutional Development
Henderson County Junior College
Cardinal Drive
Athens, Texas 75751

(214) 675-6318

February 15, 1985

APPENDIX D

1st Quarterly Report
Fiber Optics Technician
Curriculum Research Project

3. Period covered from November 1, 1984 to February 15, 1985

4. Major activities and accomplishments

During this reporting period, the major activities and accomplishments include beginning the literature search, formation of the advisory committee, and site visits to business and industry.

Literature Search

The literature search for Fiber-Optics Technician was begun at the library of Texas State Technical Institute in Waco by consultant Nancy Neill. Work continues by Alice Woodard. Articles have been pulled from technical journals and newsletters at TSTI, and Southern Methodist University Science Library was utilized for some missing articles and journals. At East Texas State University, an on-line computer search was performed, with four data bases being scanned. The data bases include Educational Research Information Clearinghouse (ERIC), Dissertation Abstracts, ABI/Inform (business data base), and Inspec (computer data base). A search at Baylor Library yielded an important publication, A Handbook on Modifying Vocational Curricula for Handicapped Students.

Advisory Committee

Preliminary calls went out to advisory committee candidates the third week in December, with the committee being finalized before Christmas. Thirteen industry representatives agreed to serve. Follow-up letters setting the first meeting date and outlining the project were mailed over the Christmas holidays. The first advisory committee meeting was held on January 19, 1985, at the Texas Education Agency Building, Room 105, Austin, from 11:00 to 3:30 p.m. Twelve of the thirteen members attended the meeting. A brisk discussion evolved and continued throughout the day, during which the committee voiced the concern that students in such a program as this be well-trained in electronics, optics, and computers.

Two advisory committee members have since been added, bringing the total committee to fifteen.

Dr. Jim Horton (214) 659-5229
President
North Lake College
5001 N. MacArthur Blvd.
Irving, Tx 75062

Mrs. Louise Tye
Teacher-Educator
East Texas State University
E. T. Station
Commerce, Tx 75428

Site visits

Site visits began immediately following the advisory committee meeting, two being made in Dallas on Janaury 16 and 17, 1985. Project staff members interviewed two fiber optics technicians at Varo, Inc. in Dallas, a preliminary task analysis completed with each of them. Honeywell Optoelectronics in Richardson was the second site visited, with two fiber optics technicians interviewed.

Committee member John Anderson arranged for the staff researcher to attend a fiber optics conference sponsored by Gulf States, Inc., in Houston. The conference, entitled "Fiber Optics-Basics, Installation and Industrial Applications", was geared as an information meeting for industries across the United States interested in using the new technology. The staff researcher interviewed several participants at the conference, obtaining information about projected employment needs and job responsibilities for a fiber optics technician. A list of conference participants has been maintained as a good beginning for a network of fiber optics users across the U.S.

5. Significant findings and events

One significant finding was that the advisory committee made a preliminary recommendation that fiber optics should be an addition to a basic electronics-optics course of study, rather than a stand-alone specialized course. The consensus of the committee was that with a good understanding of optics the student would be able to move into one of several fields of employment.

Another preliminary finding concerning future employment needs was the wide range of responses from fiber optics users. The largest employment demand presently seems to be for cable splicers in the telecommunications industry; however, the literature search has revealed that applications of fiber optics is increasing in ever-widening circles and the demand for technicians will only increase as use of fiber optics increases. Personal interviews confirm the literature search findings.

6. Problems

The project staff has not encountered any unforeseen problems.

7. Data collection

Data collection has begun through the use of on-the-job personal interviews with fiber optics technicians. From these interviews, a preliminary task analysis has been prepared. In addition, a needs assessment to begin collecting employer information is in rough draft form and will be submitted to the advisory committee before being finalized.

8. Progress on evaluation plans and procedures

An evaluation form for the first advisory committee meeting was distributed to that group on January 9, 1985. Two committee members have evaluated the session and have returned their forms to the project staff. A follow-up letter to the committee is planned.

9. Staff employment and development

There has been no additional staff employment or staff development.

10. Future activities

Activity 2, 3, and 4 are virtually completed. Activities 5 and 6 will be pursued, with two more visits to business-industry for further defining the key elements of the Fiber Optics Technician training. This will be accomplished by using the Fiber Optics Technician Task-Inventory survey (now in rough draft form) and by personal interview.

The employer needs assessment will be mailed to approximately fifty employers across the state, with the hope of having them returned by mid-March. The list of employers will be gathered from The National Directory of Addresses and Telephone Numbers.

The advisory committee will be reconvened in mid-March to review and evaluate the work of the project.

Second Quarterly Report
Fiber Optics Technician

of the

Research Coordinating Unit
Texas Education Agency
201 E. 11th Street
Austin, Texas 78701
(512) 834-4165

by

Herschel K. Whittington
Project Director

Office of Institutional Development
Henderson County Junior College
Athens, Texas 75751
(214) 675-6318

June 7, 1985

Second Quarterly Report
Fiber Optics Technician
Curriculum Research Report

3. **Period covered: February 16, 1985 to May 31, 1985**

4. **Major activities and accomplishments**

During this reporting period, the major activities and accomplishments of the project include the completion of the literature search and site visits, the completion of the task analyses, the formulation of the curriculum, and the second advisory committee meeting.

Literature Search

The literature search was concluded in mid-April with some follow-up work completed at the T.S.T.I. library. Lists and descriptions of industries using fiber optics technology were compiled, and lists of job responsibilities for technicians were begun, based on material pulled from journal articles, books, and pamphlets. Articles from the computer search were obtained through the East Texas State Reference Library. Textbooks used in teaching fiber optics modules were examined and checked for reading level.

Advisory Committee

The second advisory committee was held in Austin on April 10, 1985, in the Coordinating Board Building conference room. Committee members present for the meeting included Messrs. Charles Paulsen, James Head, Dave Benzel, Charles Dale, Bruce Plummer, Hugh Upton, Claude Speed, and Ms. Pat Lindley and Nancy Neill.

Major work for the committee for the day included consideration of a course of study proposed by the project staff; consideration of course descriptions; method of program evaluation; and equipment needed for instruction.

Site visits

The project staff concluded site visits with a trip to NASA in Houston to learn about the LAN installed by Computer Sciences. Advisory committee members arranged a visit to the Lockheed facilities at NASA, where two fiber optics technicians were interviewed. The technicians provided in-depth analyses of their job duties, and they spoke to the training needs of technicians and members of management. Curriculum outlines were provided to be used as examples of in-house training.

Task Analysis

The task analysis was sent to members of the advisory committee, who field tested it, and then made recommendations to the staff for changes. The revised task analysis was mailed to fifty-five companies across Texas, and it was used in on-site visits to determine specific tasks of a fiber optics technician.

Needs Assessment

The needs assessment form was sent to committee members, along with the task analysis, for their review. It was not modified, and was mailed out to the fifty-five selected companies. Returns were tabulated and used to project Texas industry needs for the final report.

5. **Significant findings and events**

Significant findings include the lack of well-balanced teaching materials for fiber-optics technician modules. Instructors in vocational-technical programs are using collections of materials from several sources which touch on fiber optics, including design manuals produced by fiber optics manufacturing companies.

Survey returns were slow coming back; however, we did get 30 percent returns. Those companies responding indicated that there will be an overall increase of 56 percent in the number of fiber optics technicians needed between 1985 and 1990.

Another significant finding was that the recommendations made by our advisory committee concerning tasks of fiber optics technicians and the general knowledge requirements were pretty much in accordance with our survey results. There were no significant differences in what committee members had projected and findings.

6. **Problems**

The project staff has not encountered any unforeseen problems. Work has progressed on schedule.

7. Data Collection

Design of data collection instruments began immediately after our first advisory committee meeting. The project consultant, Nancy Neill, recommended a shortened form; the advisory committee liked the shortened form, also. The two survey forms, Needs Assessment and Task Analysis, were mailed to fifty-five selected Texas companies. The project staff attempted to survey a good cross section of industries. Returns from the two forms have been tabulated and results will appear in the final report.

8. **Progress on evaluation plans and procedures.**

The second committee meeting was evaluated by members and rated as satisfactory. Two committee members, Paulsen and Head, felt that committee input was extremely valuable in the formulation of the curriculum and was instrumental in getting the kind of training program industry wants to see developed. One of the members expressed the desire to have another meeting to review the completed project, but felt it "would be nice", rather than being necessary.

9. Staff employment and development

There has been no additional staff employment or staff development.

10. Future activities

The final project activities, preparing the final report and completing the suggested curriculum guide, are underway. It is anticipated that all work on the project will be completed by June 30, 1985.

APPENDIX E

Henderson County Junior College

Athens, Texas 75751

Dear Sir:

The Institutional Development Division of Henderson County Junior College has been awarded a curriculum research project by the Texas Education Agency to determine the need for a two-year vocational technical program, Fiber Optics Technician. The aim of the project is threefold:

1. to determine through job/task analysis the role of a fiber optics technician;

2. to survey industry to determine the need for such employees;

3. to develop an appropriate curriculum for fiber optics technician training.

To obtain objectives #1 and #2, we are surveying Texas industries to determine the extent of their need for fiber optics technicians and the role of the fiber optics technician. Will you please help us with our survey by completing the attached questionnaire? We'd like to have the form returned to us by March 15, then, we'll tabulate our results and report back to Texas Education Agency this summer.

Thank you for helping us gather pertinent data about one way we in postsecondary education can better prepare our students to enter the job market in Texas industry.

Sincerely,

Alice Woodard, Ed.D.
Director of Research
Fiber Optics Technician Project

AW:bd

Enclosures

HENDERSON COUNTY JUNIOR COLLEGE
FIBER OPTICS TECHNICIAN
TASK-INVENTORY SURVEY

Fiber Optics Systems and Devices	TASKS										
	INSTALL	OPERATE	MAINTAIN	MEASURE	MODIFY	TROUBLESHOOT AND/OR REPAIR	CALIBRATE AND/OR ADJUST	SPECIFY AND RECOMMEND	INTERPRET CODES AND REGULATIONS	EVALUATE PERFORMANCE	PERFORM RELATIVE CALCULATIONS
Fiber											
·history,evolution											
·structure											
·basic theory											
·waveguide types											
·packaging											
·physical properties of optical fiber waveguides											
·optical characteristics											
·fiber evaluation methods											
·measurements of optical characteristics of fiber waveguides											
·measurement of mechanical characteristics of fiber waveguides											
·fiber-fabrication processes											
·fiber-drawing processes											
Fiber Cables											
·strength members											
·cable structures											
·cable testing											

Response Format

I - Infrequently: Monthly
O - Occasionally: Weekly
F - Frequently: Daily

HENDERSON COUNTY JUNIOR COLLEGE
FIBER OPTICS TECHNICIAN
TASK-INVENTORY SURVEY

Fiber Optics Systems and Devices	TASKS										
	INSTALL	OPERATE	MAINTAIN	MEASURE	MODIFY	TROUBLESHOOT AND/OR REPAIR	CALIBRATE AND/OR ADJUST	SPECIFY AND RECOMMEND	INTERPRET CODES AND REGULATIONS	EVALUATE PERFORMANCE	PERFORM RELATIVE CALCULATIONS
Light Sources											
·basics of light physics											
·types of light sources											
incandescent lamps											
arc lamp											
lasers											
LED											
ILD											
Modulation and Detection											
·photodetectors											
photoemissive devices											
photoconductive devices											
photovoltaic devices											
·receiver design considerations											
Fiber connectors, splices and couplers											
·coupling power loss											
·end preparation											
·optical fiber splicing											
·optical fiber connectors											
·couplers											
·coupling power loss											
·alignment mechanics											
Systems											
·transmission digital/analog											
·distribution											
·											
·system											

Response Format

I - Infrequently: Monthly
O - Occasionally: Weekly
F - Frequently: Daily

HENDERSON COUNTY JUNIOR COLLEGE
FIBER OPTICS TECHNICIAN
TASK-INVENTORY SURVEY

Optoelectronic Devices and Components	TASKS										
	INSTALL	OPERATE	MAINTAIN	MEASURE	MODIFY	TROUBLESHOOT AND/OR REPAIR	CALIBRATE AND/OR ADJUST	SPECIFY AND RECOMMEND	INTERPRET CODES AND REGULATIONS	EVALUATE PERFORMANCE	PERFORM RELATIVE CALCULATIONS
Photodiodes											
LED											
~~multiplexing LED~~ displays											
monolithic display											
~~intelligent~~ displays											
ILD											
Photo transistor											
Opto-isolators											
Safety in Optoelectronics											
Solid lasers											
Solid-crystal laser											
Gas laser											
Neutral-atom gas laser											
Ion gas laser											
Graphite plasma tube											
Molecular gas laser											
Liquid lasers											
Optic sets											
TEM											
Laser optics alignment											
Dye laser tuning											
Photometer											
Radiometer											
Laser power meter											

Response Format

I - Infrequently: Monthly
O - Occasionally: Weekly
F - Frequently: Daily

ELECTRICAL/ ILLUMINATION DEVICES	TASKS										
	INSTALL	OPERATE	MAINTAIN	MEASURE	MODIFY	TROUBLESHOOT AND/OR REPAIR	CALIBRATE AND/OR ADJUST	SPECIFY AND RECOMMEND	INTERPRET CODES AND REGULATIONS	EVALUATE PERFORMANCE	PERFORM RELATIVE CALCULATIONS
WIRING/CABLES											
SWITCHING GEARS											
FUSE BOXES/FUSES											
CIRCUIT BREAKER BOXES/CIRCUIT BREAKERS											
CONDUIT											
LAMP FIXTURES											
BALLASTS/STARTERS											
LAMPS/INCANDESCENT											
LAMPS/FLUORESCENT											
LAMPS/GAS DIS-CHARGE											
SOLID STATE DIMMERS											
TIMERS											
CONNECTORS											
CONVENIENCE OUTLETS											
TRANSFORMERS											

Response Format

I - Infrequently: Monthly
O - Occasionally: Weekly
F - Frequently: Daily

HENDERSON COUNTY JUNIOR COLLEGE
FIBER OPTICS TECHNICIAN
TASK-INVENTORY SURVEY

ELECTRO-MECHANICAL DEVICES	TASKS										
	INSTALL	OPERATE	MAINTAIN	MEASURE	MODIFY	TROUBLESHOOT AND/OR REPAIR	CALIBRATE AND/OR ADJUST	SPECIFY AND RECOMMEND	INTERPRET CODES AND REGULATIONS	EVALUATE PERFORMANCE	PERFORM RELATIVE CALCULATIONS
MOTOR SPEED CONTROLLERS											
MOTOR STARTERS											
AUTOTRANSFORMERS											
SERVOS											
MOTORS, A.C., D.C.											
GENERATORS, A.C., D.C.											
RELAYS											
BUZZERS											
VIBRATORS											
HORNS											
BRUSHES											
CONTACTS											
STARTING CAPACITORS											
METER MOVEMENTS/ METERS											

Response Format

I - Infrequently: Monthly
O - Occasionally: Weekly
F - Frequently: Daily

HENDERSON COUNTY JUNIOR COLLEGE

FIBER OPTICS TECHNICIAN

TASK-INVENTORY SURVEY

RESEARCH AND DEVELOPMENT	TASKS										
	INSTALL	OPERATE	MAINTAIN	MEASURE	MODIFY	TROUBLESHOOT AND/OR REPAIR	CALIBRATE AND/OR ADJUST	SPECIFY AND RECOMMEND	INTERPRET CODES AND REGULATIONS	EVALUATE PERFORMANCE	PERFORM RELATIVE CALCULATIONS
[illegible]T CELLS											
FUEL CELLS											
[illegible]LOVE BOXES											
[illegible]ASTER-SLAVE MANIPULATORS											
[illegible]NTRUDER SENSOR SYSTEMS											
[illegible]ETECTION SYSTEMS											
[illegible]ERTICAL AXIS TURBINES											
[illegible]ACUUM RECOVERY SYSTEMS											
[illegible]URIFICATION SYSTEMS											
[illegible]PECTROSCOPY SYSTEMS											
[illegible]HOTOVOLTAIC GENERATORS											
[illegible]RESSURE SYSTEMS											
COMPUTERS											
[illegible]INICOMPUTERS											
MICROPROCESSORS											
GRAPHIC DISPLAY DEVICES											

Response Format

I - Infrequently: Monthly
O - Occasionally: Weekly
F - Frequently: Daily

HENDERSON COUNTY JUNIOR COLLEGE
FIBER OPTICS TECHNICIAN
TASK-INVENTORY SURVEY

RESEARCH AND DEVELOPMENT	TASKS										
	INSTALL	OPERATE	MAINTAIN	MEASURE	MODIFY	TROUBLESHOOT AND/OR REPAIR	CALIBRATE AND/OR ADJUST	SPECIFY AND RECOMMEND	INTERPRET CODES AND REGULATIONS	EVALUATE PERFORMANCE	PERFORM RELATIVE CALCULATIONS
ASSAY INSTRUMENTATION											
PULSED NEUTRON GENERATORS											
SOLAR TRACKING AND COLLECTION SYSTEMS											
SEISMIC SENSORS											
SEISMOMETERS											
ION IMPLANTATION DEVICES											
WASTE VITRIFICATION FURNACES											
MAGMA EFFECTS SIMULATION FURNACES											
THERMOELECTRIC GENERATORS											

Response Format

I - Infrequently: Monthly
O - Occasionally: Weekly
F - Frequently: Daily

HENDERSON COUNTY JUNIOR COLLEGE
FIBER OPTICS TECHNICIAN
TASK-INVENTORY SURVEY

ELECTRONIC DEVICES AND SYSTEMS	TASKS										
	INSTALL	OPERATE	MAINTAIN	MEASURE	MODIFY	TROUBLESHOOT AND/OR REPAIR	CALIBRATE AND/OR ADJUST	SPECIFY AND RECOMMEND	INTERPRET CODES AND REGULATIONS	EVALUATE PERFORMANCE	PERFORM RELATIVE CALCULATIONS
RESISTORS											
POTENTIOMETERS											
CAPACITORS											
INDUCTORS											
TRANSFORMERS											
CHOKES											
RECTIFIERS											
DIODES											
TRANSISTORS											
SCRs											
TRIACS											
VACUUM TUBES											
GASEOUS TUBES											
GATES											
INVERTERS											
LEDs											
CRTs											
OSCILLOSCOPES											
VACUUM TUBE MULTIMETERS											
LOGIC ANALYZER											

Response Format

I - Infrequently: Monthly
O - Occabionally: Weekly
F - Frequently: Daily

HENDERSON COUNTY JUNIOR COLLEGE
FIBER OPTICS TECHNICIAN
TASK-INVENTORY SURVEY

ELECTRONIC DEVICES AND SYSTEMS	TASKS										
	INSTALL	OPERATE	MAINTAIN	MEASURE	MODIFY	TROUBLESHOOT AND/OR REPAIR	CALIBRATE AND/OR ADJUST	SPECIFY AND RECOMMEND	INTERPRET CODES AND REGULATIONS	EVALUATE PERFORMANCE	PERFORM RELATIVE CALCULATIONS
TRANSISTOR DIGITAL MULTIMETERS											
OSCILLATORS											
FREQUENCY COUNTERS											
VOLT-OHMMETER											
AMP PROBE											
BRIDGES											
PHOTOVOLTAIC CELLS											
PHOTOCONDUCTIVE CELLS											
BATTERIES											

Response Format

I - Infrequently: Monthly
O - Occasionally: Weekly
F - Frequently: Daily

HENDERSON COUNTY JUNIOR COLLEGE
FIBER OPTICS TECHNICIAN
TASK-INVENTORY SURVEY

INSTRUMENTATION AND CONTROLS	TASKS										
	INSTALL	OPERATE	MAINTAIN	MEASURE	MODIFY	TROUBLESHOOT AND/OR REPAIR	CALIBRATE AND/OR ADJUST	SPECIFY AND RECOMMEND	INTERPRET CODES AND REGULATIONS	EVALUATE PERFORMANCE,	PERFORM RELATIVE CALCULATIONS
ROTAMETERS											
DIFFERENTIAL PRESSURE DEVICES											
POSITIVE DISPLACEMENT DEVICES											
PITOT TUBES											
TURBINE METERS											
ANEMOMETERS											
OPEN CHANNEL WEIRS											
MAGNETIC FLOWMETERS											
LIQUID-IN-GLASS THERMOMETERS											
LIQUID FILLED DIAL THERMOMETERS											
BI-METALLIC THERMOMETERS											
CRAYON TEMPERATURE INDICATORS											
LIQUID TEMPERATURE INDICATORS											
PELLET TEMPERATURE INDICATORS											
RESISTANCE TEMPERATURE DETECTORS											

Response Format

I - Infrequently: Monthly
O - Occabionally: Weekly
F - Frequently: Daily

HENDERSON COUNTY JUNIOR COLLEGE
FIBER OPTICS TECHNICIAN
TASK-INVENTORY SURVEY

INSTRUMENTATION AND CONTROLS	TASKS										
	INSTALL	OPERATE	MAINTAIN	MEASURE	MODIFY	TROUBLESHOOT AND/OR REPAIR	CALIBRATE AND/OR ADJUST	SPECIFY AND RECOMMEND	INTERPRET CODES AND REGULATIONS	EVALUATE PERFORMANCE	PERFORM RELATIVE CALCULATIONS
THERMOCOUPLES											
OPTICAL PYROMETERS											
TOTAL RADIATION PYROMETERS											
MANOMETERS											
LIMP DIAPHRAGM GAGES											
BOURDON AND BELLOWS GAGES											
SIGHT GAGES											
BUBBLE TUBES											
FLOAT/BUOYANCY METERS											
CAPACITANCE LEVEL GAGES											
DIRECT CURRENT METERS											
ALTERNATING CURRENT METERS											
MULTIMETERS											
GAS ANALYZERS											
SERVOS											
SOLENOIDS											

Response Format

I - Infrequently: Monthly
O - Occasionally: Weekly
F - Frequently: Daily

HENDERSON COUNTY JUNIOR COLLEGE
FIBER OPTICS TECHNICIAN
TASK-INVENTORY SURVEY

FLUID POWER SYSTEMS	TASKS										
	INSTALL	OPERATE	MAINTAIN	MEASURE	MODIFY	TROUBLESHOOT AND/OR REPAIR	CALIBRATE AND/OR ADJUST	SPECIFY AND RECOMMEND	INTERPRET CODES AND REGULATIONS	EVALUATE PERFORMANCE	PERFORM RELATIVE CALCULATIONS
REGULATORS											
HEAT EXCHANGERS											
OIL HEATERS											
DRYERS											

Response Format

I - Infrequently: Monthly
O - Occasionally: Weekly
F - Frequently: Daily

HENDERSON COUNTY JUNIOR COLLEGE
FIBER OPTICS TECHNICIAN
TASK-INVENTORY SURVEY

FLUID POWER SYSTEMS	TASKS										
	INSTALL	OPERATE	MAINTAIN	MEASURE	MODIFY	TROUBLESHOOT AND/OR REPAIR	CALIBRATE AND/OR ADJUST	SPECIFY AND RECOMMEND	INTERPRET CODES AND REGULATIONS	EVALUATE PERFORMANCE	PERFORM RELATIVE CALCULATIONS
PRESSURE MEASURING DEVICES											
PUMPS											
COMPRESSORS											
MOTORS (FLUID)											
CYLINDERS											
LIMITED ACTION ROTARY DEVICES											
HOSES											
PIPES AND TUBING											
CONNECTORS											
FITTINGS											
VALVES											
VALVE ACTUATORS											
ACCUMULATORS											
RESERVOIRS											
AUXILIARY TANKS											
SEPARATORS											
FILTERS											
STRAINERS											
LUBRICATORS											

Response Format

I - Infrequently: Monthly
O - Occasionally: Weekly
F - Frequently: Daily

HENDERSON COUNTY JUNIOR COLLEGE
FIBER OPTICS TECHNICIAN
TASK-INVENTORY SURVEY

MECHANICAL DEVICES AND SYSTEMS	TASKS										
	INSTALL	OPERATE	MAINTAIN	MEASURE	MODIFY	TROUBLESHOOT AND/OR REPAIR	CALIBRATE AND/OR ADJUST	SPECIFY AND RECOMMEND	INTERPRET CODES AND REGULATIONS	EVALUATE PERFORMANCE	PERFORM RELATIVE CALCULATIONS
BELTS											
SHEAVES											
CHAINS											
SPROCKETS											
GEARS											
TRANSMISSIONS											
SPEED REDUCERS											
SHAFTS											
COUPLINGS AND JOINTS											
BEARINGS											
SEALS											
GASKETS											
O-RINGS											
CLUTCHES											
LINKAGES											
CAMS AND CAM FOLLOWERS											
FANS AND BLOWERS											
VALVES											
PACKING											

Response Format

I - Infrequently: Monthly
O - Occasionally: Weekly
F - Frequently: Daily

HENDERSON COUNTY JUNIOR COLLEGE
FIBER OPTICS TECHNICIAN
TASK-INVENTORY SURVEY

HAND AND POWER TOOLS	TASKS										
	INSTALL	OPERATE	MAINTAIN	MEASURE	MODIFY	TROUBLESHOOT AND/OR REPAIR	CALIBRATE AND/OR ADJUST	SPECIFY AND RECOMMEND	INTERPRET CODES AND REGULATIONS	EVALUATE PERFORMANCE	PERFORM RELATIVE CALCULATIONS
CONVENTIONAL HAND TOOLS: HAMMERS											
PLIERS											
SCREWDRIVERS											
COMMON WRENCHES											
TORQUE WRENCHES											
HAND POWER TOOLS: DRILLS											
SANDERS											
GRINDERS											
SAWS											
BENCH & FLOOR POWER TOOLS: DRILL PRESSES											
BENCH GRINDERS/ POLISHERS											
MILLS											
LATHES											
SURFACERS/ PLANERS											
VISES											
SAWS											

Response Format

I - Infrequently: Monthly
O - Occasionally: Weekly
F - Frequently: Daily

HENDERSON COUNTY JUNIOR COLLEGE

FIBER OPTICS TECHNICIAN

TASK-INVENTORY SURVEY

HAND AND POWER TOOLS	TASKS										
	INSTALL	OPERATE	MAINTAIN	MEASURE	MODIFY	TROUBLESHOOT AND/OR REPAIR	CALIBRATE AND/OR ADJUST	SPECIFY AND RECOMMEND	INTERPRET CODES AND REGULATIONS	EVALUATE PERFORMANCE	PERFORM RELATIVE CALCULATIONS
METAL WORKING TOOLS: HAND BREAKS											
HAND SHEARS											
NOTCHERS											
PRECISION MEASURING DEVICES: LEVELS											
SQUARES											
RULES											
MICROMETERS											
RADIUS GAGES											
OTHER DIAL TYPE GAGES											
DRAWING TOOLS: T-SQUARES											
TRIANGLES											
COMPASSES											
DIVIDERS											
TEMPLATES											
CURVES											
MARKING INSTRUMENTS											

Response Format

I - Infrequently: Monthly
O - Occasionally: Weekly
F - Frequently: Daily

HENDERSON COUNTY JUNIOR COLLEGE
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TASK-INVENTORY SURVEY

HAND AND POWER TOOLS	TASKS										
	INSTALL	OPERATE	MAINTAIN	MEASURE	MODIFY	TROUBLESHOOT AND/OR REPAIR	CALIBRATE AND/OR ADJUST	SPECIFY AND RECOMMEND	INTERPRET CODES AND REGULATIONS	EVALUATE PERFORMANCE	PERFORM RELATIVE CALCULATIONS
LETTERING DEVICES											

Response Format

I - Infrequently: Monthly
O - Occasionally: Weekly
F - Frequently: Daily

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FIBER OPTICS TECHNICIAN

TASK-INVENTORY SURVEY

MISCELLANEOUS SYSTEMS	TASKS										
	INSTALL	OPERATE	MAINTAIN	MEASURE	MODIFY	TROUBLESHOOT AND/OR REPAIR	CALIBRATE AND/OR ADJUST	SPECIFY AND RECOMMEND	INTERPRET CODES AND REGULATIONS	EVALUATE PERFORMANCE	PERFORM RELATIVE CALCULATIONS
BOILERS											
SUPERHEATERS											
TURBINES											
SOLAR HOT WATER											
SOLAR HOT AIR											
HEAT PUMPS											
WASTE HEAT RECOVERY SYSTEMS											
MICROCOMPUTERS											
HVAC SYSTEMS											
ELEVATORS AND ESCALATORS											
LIGHTING/ILLUMINATION											

Response Format

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F - Frequently: Daily

MISCELLANEOUS ADDITIONS	TASKS										
	INSTALL	OPERATE	MAINTAIN	MEASURE	MODIFY	TROUBLESHOOT AND/OR REPAIR	CALIBRATE AND/OR ADJUST	SPECIFY AND RECOMMEND	INTERPRET CODES AND REGULATIONS	EVALUATE PERFORMANCE	PERFORM RELATIVE CALCULATIONS
HVAC Control Sys.											
Insulation											
Caulking, etc.											
Load Management Devices (Whole Sys.)											
Air Compressors											
Compressed Air Dryers											
Chillers:											
Absorption											
Centrifugal											
Reciprocating											
Evaporators											
Demineralizers											
Softners											

Response Format

I - Infrequently: Monthly
O - Occasionally: Weekly
F - Frequently: Daily

RESEARCH AND DEVELOPMENT	TASKS										
	INSTALL	OPERATE	MAINTAIN	MEASURE	MODIFY	TROUBLESHOOT AND/OR REPAIR	CALIBRATE AND/OR ADJUST	SPECIFY AND RECOMMEND	INTERPRET CODES AND REGULATIONS	EVALUATE PERFORMANCE	PERFORM RELATIVE CALCULATIONS
Explosives and Explosive Devices											
Cryogenic Systems											
Superconducting Magnets											
Silicon Solar Cells											
Electro-Optic Fibers & Couplers											

Response Format

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F - Frequently: Daily

HENDERSON COUNTY JUNIOR COLLEGE

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TASK-INVENTORY SURVEY

MISCELLANEOUS ADDITIONS	TASKS (REVISED)										
	INSTALL	LOCATE	MAINTAIN	MEASURE	MODIFY OR WRITE	TROUBLESHOOT AND/OR REPAIR	CALIBRATE AND/OR ADJUST	SPECIFY AND RECOMMEND	INTERPRET	EVALUATE	PERFORM RELATIVE CALCULATIONS
Blueprints											
Specifications											
Data											
Reports											
Comp. Output											
Catalogs											
Published Literature											

Response Format

I - Infrequently: Monthly
O - Occasionally: Weekly
F - Frequently: Daily

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APPENDIX F

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APPENDIX G

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